Urban Search & Rescue Robot (USRR)

Abstract

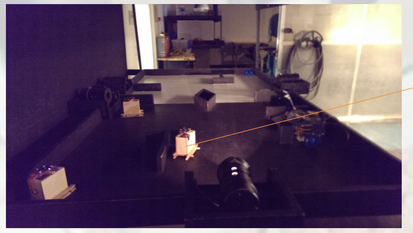
A rescue robot is a robot that has been designed for the purpose of aiding rescue workers. Common situations that employ rescue robots are mining accidents, urban disasters, hostage situations, and explosions. The benefits of rescue robots to these operations include reduced personnel requirements, reduced fatigue, and access to otherwise unreachable areas. This particular urban search and rescue robot (USRR) had one specific purpose, to rescue in the most efficient possible. For a burning building, a small robot is required to get to a trapped human, which is represented by an infrared light. Once the human is found, a health package or medicine is dropped off to assist them.

The goal was to construct an urban search and rescue robot capable of dropping a cube 12 inches from an infrared beacon while avoiding obstacles in its path and adapt to a dynamic environment. The robot had to utilize various pieces of equipment to accomplish its task. Such equipment included various sensors to detect distance and light and a drop-off mechanism consisting of an arm and funnel. Other than rescue operations, this project demonstrated that such a design has great potential for applications in space as well. Some include creating a marker on different planets for future explorers.

Objectives

- Control USRR robot using a Joystick
- Use an Infrared sensor to detect infrared light towers
- Use a proximity sensor to measure distance between USRR and tower
- Create an effective and efficient drop-off mechanism or a package release

The Arena

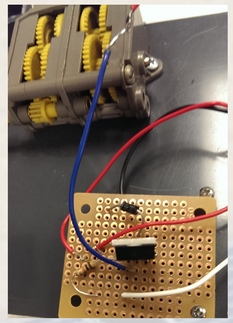


Specifications:
- 3 Infrared Light towers
- Multiple obstacles

Electrical Engineering

Third Motor Circuit:

This circuit uses 3 main components: 1N4001 Diode, TIP121 NPN Transistor, 10k Ohm Resistor, and the motor. The purpose of this circuit is to drive the third motor and deploy the cube using the drop off mechanism employed on our robot. The resistor is used to limit current flow to the Arduino Digital output pin so it doesn't burn out.



Sensors:

Infrared Sensor:
An electronic instrument that is used to sense certain characteristics of its surroundings by either emitting and/or detecting infrared radiation.

Proximity Sensor:
A sensor able to detect the presence of nearby objects without any physical contact. Often emits an electromagnetic field and looks for changes in the field or return signal.

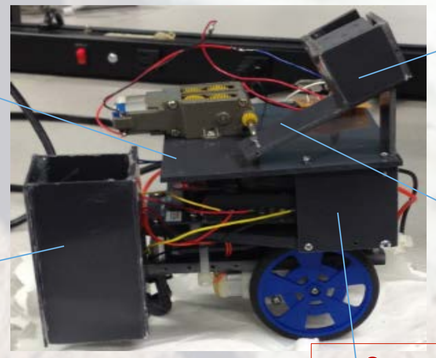
PIC Board-
- Arduino UNO
- A/D terminals
- Motor/Battery/Software terminals
- Programmable LED's

Mechanical Engineering

Design Matrix

Urban Search and Rescue Project Alternative Design Matrix

		All Combinations of Design Parameters comprising Conceptual Designs							
		Ramp		Conveyor belt		Arm & Funnel		Pulley	
Lowering Mechanism		Inclined Plane		Belt with incline plane		Arm & Funnel		Block-and-tackle	
Able to be powered by motor		Yes		Yes		Yes		Difficult	
Drop Cube within range		Difficult		Difficult		Yes		Yes	
Acceptance Criteria (as many as team likes)	Weight (by %) of Acceptance Criteria (apply last)	Scoring of the importance of each Conceptual Design in meeting Acceptance Criteria (Max 10)	Weighted Score	Scoring of the importance of each Conceptual Design in meeting Acceptance Criteria (Max 10)	Weighted Score	Scoring of the importance of each Conceptual Design in meeting Acceptance Criteria (Max 10)	Weighted Score	Scoring of the importance of each Conceptual Design in meeting Acceptance Criteria (Max 10)	Weighted Score
Aesthetics	15%	7	1.05	9	1.35	8	1.20	8	1.20
Accuracy	25%	7	1.75	7	1.75	9	2.25	7	1.75
Efficiency	25%	8	2.00	8	2.00	9	2.25	6	1.50
Weight(Light)	15%	7	1.05	7	1.05	8	1.20	8	1.20
Complexity	20%	6	1.20	9	1.80	9	1.80	8	1.60
Total Percentage =	100%		7.05		7.95		**8.70**		7.25

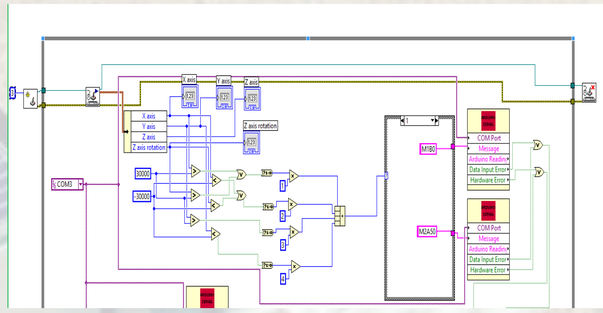


- **Base**
  - Dimensions: 3" by 4.5"
  - Provides a foundation for the drop-off mechanism
- **Funnel**
  - Dimensions: 2" by 3" long
  - Positioned close to ground so cube doesn't bounce around and lands in exact spot
- **Cube Holder**
  - Dimensions: 1.2" square
  - Provides a foundation for the drop-off mechanism
- **Arm**
  - Dimensions: 3" long by 1" wide
  - Connected to motor via shaft to allow arm to be turned
- **Support**
  - Dimensions: 2" by 2"
  - Provides foundation for base

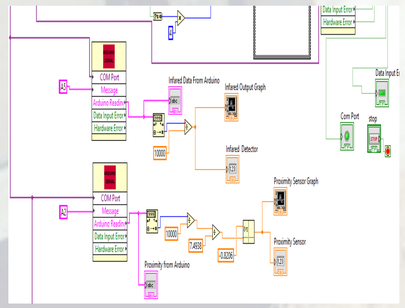
Software Engineering

The software used to allow the USRR to successfully compete its mission is National Instruments LabView 2011. This is an highly productive development environment for creating custom applications that interact with real-world data or signals in fields such as science and engineering. Below are images of the main block diagram which consists of the code for the movement, sensor data, and package release. The front panel is the output of the program for user interface.

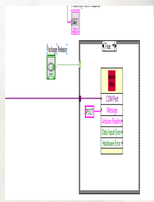
Movement



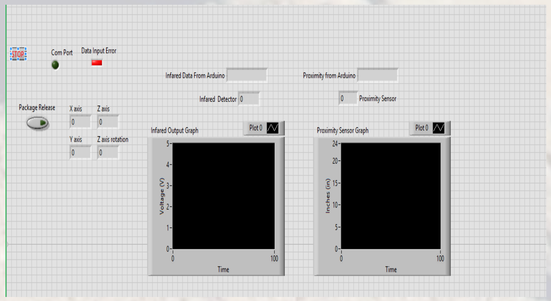
Sensor Data Acquisition



Package Release



Front Panel (Output)



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